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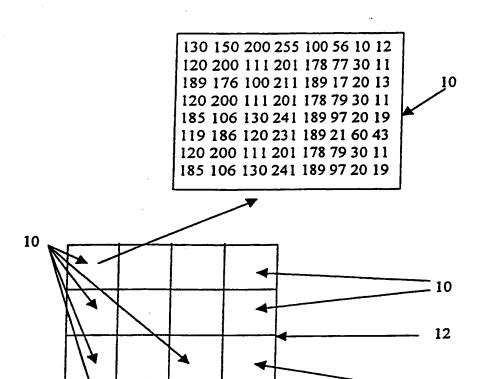


FIGURE 1

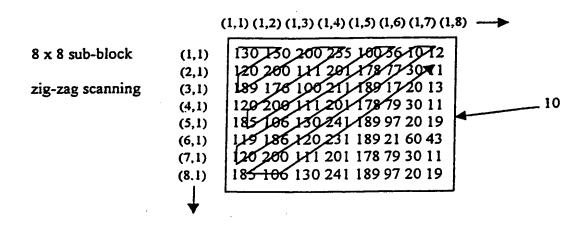
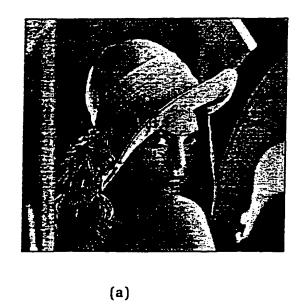


FIGURE 2

SUBSTITUTE SHEET (RULE 26)

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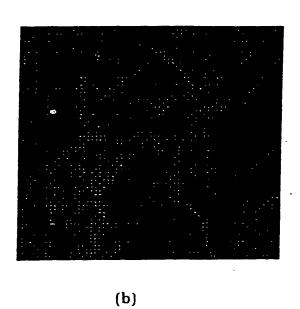
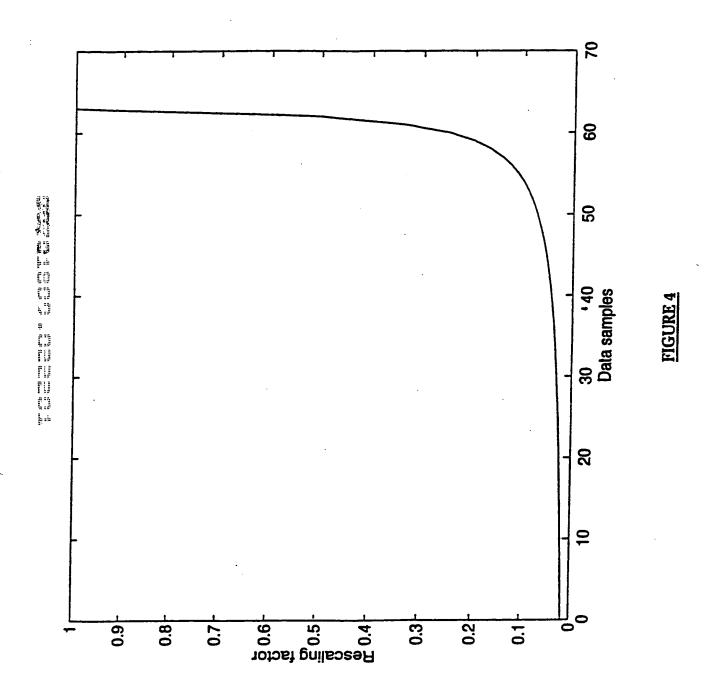


FIGURE 3





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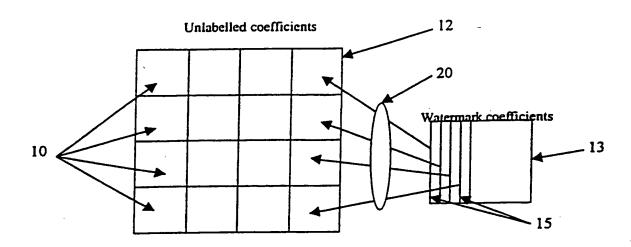


FIGURE 5

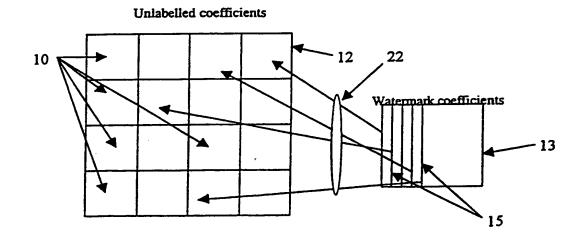


FIGURE 6

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PSEUDOCODE

PROCEDURE WATERMARK CODER

BEGIN

READ UNLABELLED DATA; CONVERT UNLABELLED DATA TO MATRIX (M,N); PERFORM SUB-BLOCKING of UNLABELLED DATA; PERFORM DCT ON UNLABELLED DATA SUB-BLOCKS; RE-ORDER DCT COEFFICIENTS TO FOLLOW ZIG-ZAG PATTERN; DETERMINE AC ENERGIES OF DCT COEFFICIENTS; SET THRESHOLD BASED ON AC ENERGY MEAN AND STANDARD DEVIATION; COMPARE SUB-BLOCK AC ENERGIES WITH THRESHOLD; IF AC ENERGIES LESS THAN THRESHOLD THEN

ELSE

SET TO OFFSET SPATIAL LOCATIONS;

STORE SPATIAL LOCATIONS:

END

GENERATE UNIQUE KEY FROM STRUCTURED/RANDOM SPATIAL LOCATIONS: STORE UNIQUE KEY FOR DECODING;

READ WATERMARK DATA:

CONVERT WATERMARK DATA TO MATRIX (J,K); PERFORM SUB-BLOCKING of WATERMARK DATA; PERFORM DCT ON UNLABELLED DATA SUB-BLOCKS; RE-ORDER DCT COEFFICIENTS TO FOLLOW ZIG-ZAG PATTERN; RE-SCALE DCT COEFFICIENTS USING EXPONENTIAL FILTER;

EMBED RE-SCALED WATERMARK DCT COEFFICIENTS INTO UNLABELLED DCT SUB-BLOCKS: CONVERT ZIG-ZAG SCAN BACK TO NORMAL SCAN; INVERSE DCT SUB-BLOCKS TO OBTAIN LABELED DATA;

END

FIGURE 8a

PSEUDOCODE

PROCEDURE WATERMARK DECODER

BEGIN

READ LABELED DATA; CONVERT LABELED DATA TO MATRIX (M,N); PERFORM SUB-BLOCKING of LABELED DATA; PERFORM DCT ON LABELED DATA SUB-BLOCKS; RE-ORDER DCT COEFFICIENTS TO FOLLOW ZIG-ZAG PATTERN;

EXTRACT SPATIAL LOCATIONS FROM UNIQUE KEY;
DECODE WATERMARK DCT COEFFICIENTS FROM SPATIAL
LOCATIONS;
SCALE WATERMARK DCT COEFFICIENTS USING INVERSE
EXPONENTIAL FILTER;
CONVERT ZIG-ZAG SCAN BACK TO NORMAL SCAN;
INVERSE DCT SUB-BLOCKS TO OBTAIN WATERMARK DATA;

END

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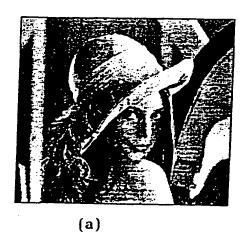
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FIGURE 8b

PCT/SG98/00039



(a)





(b)

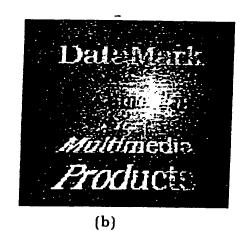
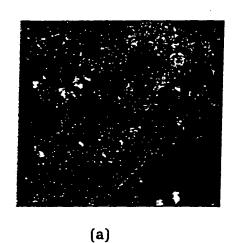
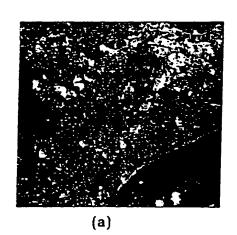


FIGURE 9







(b)

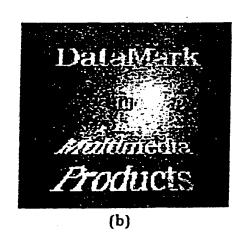


FIGURE 10

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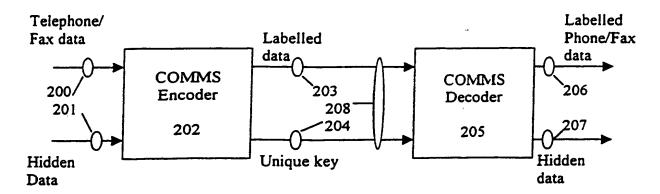


FIGURE 11

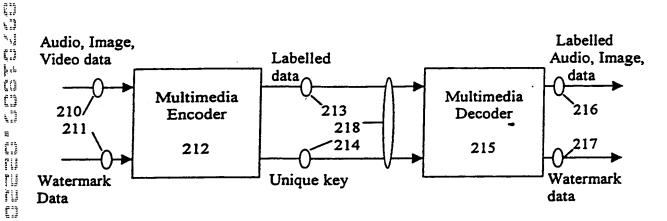


FIGURE 12

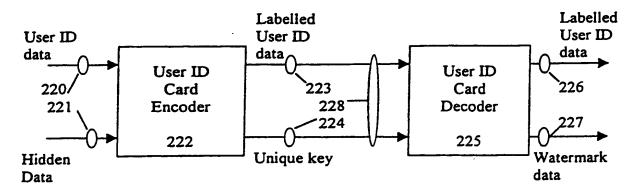


FIGURE 13